

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

WATER WELL

(No.)

Code 642

DEFINITION

A hole drilled, dug, driven, bored, jetted or otherwise constructed to an aquifer.

PURPOSES

To provide water for livestock, wildlife, irrigation, and other uses.

To provide for general water needs of farming/ranching operations.

To facilitate proper use of vegetation on rangeland, pastures, and wildlife areas.

CONDITION WHERE PRACTICE APPLIES

On all land uses where the underground supply of water is sufficient in quantity and quality for the intended purpose.

This practice standard applies only to production wells. Specifically excluded are any types of wells installed solely for monitoring or observation purposes, injection wells, and piezometers. The standard does not apply to pumps installed in wells; above ground installations, such as pumping plants, pipelines, and tanks; temporary test wells; and decommissioning of wells Conservation Practice Standard *Well Decommissioning* (Code 351)).

CRITERIA

Installation of this practice should be in consideration of natural resource assessments that may be applicable, such as cultural resources, NEPA, wetland conservation provisions, existing wildlife habitat, and others.

Suitability of Site: The availability of groundwater for its intended use at the site shall be determined by using reliable local experience and reviewing all available relevant geologic maps and reports; well records maintained by Kentucky Division of Water Groundwater Branch, Kentucky Geological Survey, the local county health department, federal agencies; and design, construction, and maintenance records of near by wells. An appropriate level of investigation, including test well drilling, is conducted on-site, as needed, prior to well construction to determine site-specific hydrogeologic conditions.

The site shall be suitable for safe operation of the drilling equipment.

Well Head Protection: Wells shall be located at safe distances from potential sources of pollution, including unsealed abandoned wells. The allowable distance shall be based on consideration of site-specific hydrogeologic factors and shall comply with requirements of all applicable Kentucky Department of Health or local regulations or constructions codes.

Surface runoff and drainage that might reach the wellhead from areas used by livestock shall be diverted.

Wells shall be located a safe distance from both overhead and underground utility lines and other safety hazards.

Borehole: Drilled, jetted, bored, and driven wells shall be sufficiently round, straight, and of adequate diameter to permit satisfactory installation of inlet, well casing, filter pack, and annular seal, and passage of tremie pipe (including couplings), if used.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

Use of Casing: Casing shall be installed to seal out undesirable surface or shallow groundwater and to support the side of the hole through unstable earth materials. The intake portion of a well through stable geologic formations may not require casing.

Casing Diameter: Casing diameter shall be sized to permit satisfactory installation and efficient operation of the pump, and large enough to assure that uphole velocity is 5 feet per second or less, to protect against excessive head loss.

Materials: Casings may be of steel, iron, stainless steel, copper alloys, plastic, fiberglass, concrete, or other material of equivalent strength and durability consistent with the intended use of the water and the maximum anticipated differential head between the inside and outside of the casing.

Steel well casing shall meet or exceed requirements specified in ASTM A 589. Steel pipe manufactured for other purposes may be used if the quality of the pipe meets or exceeds requirements specified in ASTM 589.

Only steel pipe casings shall be used in driven wells.

To prevent galvanic corrosion, dissimilar metals shall not be joined.

Table 1: Minimum thickness of metal casings for livestock or recreation wells, in inches.

Diameter In.	Steel Casing In.	Lightweight Galvanized Casing * In.
1 **	0.133	
1 1/2 **	0.145	
2 **	0.154	
2 1/2 **	0.203	
4	0.060	0.0322
4 1/2	0.060	0.0322
5	0.075	0.0382
6	0.105	0.0382
8	0.105	0.0486
10	0.105	0.0486

* Lightweight galvanized casing shall be used only in areas where local experience has proved it to be satisfactory.

** Use only for driven or artesian wells.

Plastic casings made of acrylonitrile-butadiene-styrene (ABS), polyvinyl chloride (PVS), or styrene-rubber (SR) shall conform to material, dimensional and quality requirements specified in ASTM F 480.

Table 2: Maximum depth of installation for plastic (SDR-PR) pipe, in feet.

SDR	PVC Modulus 400K	PVC Of 320K	ABS Elasticity 250K	SR (E) 300K
13.5	985 ft	785	615 ft	735
17	475	380	295	355
21	245	200	150	185
26	130	100	80	95
32.5	65	50	40	50

Table 3: Dimensions and maximum depth of installation for schedule 40 PVC plastic pipe with a modulus of elasticity of 400,000 lb/in².

Schedule 40

Nominal Diameter In.	Outside Diameter In.	Min. Wall Thickness In.	SDR	Max. Depth Ft.
2	2.375	0.154	15.4	650
2 1/2	2.875	0.203	14.2	840
3	3.5	0.216	16.2	550
3 1/2	4.00	0.226	17.7	420
4	4.50	0.237	19.0	340
5	5.563	0.258	21.6	230
6	6.625	0.280	23.7	170
8	8.625	0.322	26.8	120
10	10.75	0.365	29.5	90
12	12.75	0.406	31.4	60

If the water is to be used for human consumption, plastic pipe shall be approved by the National Sanitation Foundation.

Plastic pipe manufactured for water or irrigation pipelines may be used if the quality equals or exceeds requirements specified in ASTM F 480.

Filament-wound fiberglass casings (glass-fiber-reinforced-thermosetting-resin pipe, RTRP) may be used if material meets requirements specified in ASTM D 2996. Tests

for long-term cyclic pressure strength, long-term static pressure strength, and short-term rupture strength as required in ASTM D 2996 are not needed because the pipe is to be used for well casing. Joints shall meet requirements specified in Section 3.8, ASTM F 480.

Fiberglass pressure pipe, (also called reinforced plastic mortar pipe, RPMP, or fiberglass pipe with aggregate) shall meet or exceed requirements specified in ASTM D 3517.

The maximum depth for well casings shall be based on critical collapse pressure calculated by the Cleideinst Equation in ASTM F 480, Appendix X2. Depth, as used in this standard, applies to the difference in static head between the inside and outside of the casing. This can be determined by measuring the static head or by using the total depth of the well.

Casing Strength: Well casing wall thickness shall be sufficient to withstand all anticipated static and dynamic pressures imposed on the casing during installation, well development, and use. See Tables 1, 2, and 3 above.

Joint Strength: Joints for well casings shall have adequate strength to carry the load due to the casing length and still be watertight, or shall be mechanically supported during installation to maintain joint integrity. Such mechanically supported casings shall terminate on firm material that can adequately support the casing weight.

Screen: All wells constructed to recover water from consolidated aquifers shall be equipped with manufactured screen sections, well points, or field perforated sections meeting the criteria stated below. The screen openings for aquifer material of near uniform size shall be smaller than the average diameter of the aquifer material. The screen or slotted casing section must be protected with a device immediately above the intake section if necessary to prevent well stabilizer materials from entering the intake section area.

For graded aquifer materials (of non-uniform gradation), the screen shall be sized so that 25 to 40 percent of the aquifer material is larger than the screen opening. For wells in which a gravel pack envelope is used, the screen shall have openings that will exclude at least 85 percent of the gravel pack material. The length and open area of the screen shall be adequate to maintain the entrance

velocity of water into the well at an acceptable level, preferably less than 0.1 foot/second.

The position of the screen in the well shall be governed by the depth of the aquifer below the ground surface and the thickness of the aquifer to be penetrated by the well. If practical, the top elevation of the screen shall be below the lowest water level expected during pumping and be located opposite the most permeable area in the water-bearing strata.

Seals (Packers): Telescoped screen assemblies shall be provided with one or more sand-tight seals between the top of the telescoped screen assembly and casing.

Filter Pack: Installation of a filter pack around the well screen shall be considered under the following conditions: presence of a poorly graded, fine sand aquifer; presence of a highly variable aquifer, such as alternating sand and clay layers; presence of a poorly cemented sandstone or similar aquifer; a requirement for maximum yield from a low-yielding aquifer; and holes drilled by reverse circulation. If used, filter pack should consist of sand or gravel material having a D30 grain size 4 to 12 times the D30 grain size of the aquifer materials. Provisions shall be made for centering the casing in the filter pack.

Prepacked Well Screens: For heaving or caving sands, silty or fine-grained aquifers, and for horizontal or angled wells, a commercial prepacked well screen may be substituted for a conventionally installed (by tremie) filter pack.

Installation: Casing shall extend from above the ground surface down through unstable earth materials to an elevation of at least 2 feet into stable material or to the top of the screen.

All wells shall be cased to a sufficient height (minimum of 18 inches) above the ground surface to prevent entry of surface water.

Casing for artesian aquifers shall be sealed into overlying, impermeable formations in such a manner as to retain confining pressure.

If a zone is penetrated that is determined or suspected to contain water of quality unsuitable for intended use, the zone shall be

sealed to prevent infiltration of the poor-quality water into the well and the developed portion of the aquifer.

Well Development: Wells to be completed without a filter pack in unconsolidated granular aquifers shall be developed following guidance provided in ASTM D 5521, Standard Guide for Development of Ground-Water Monitoring Wells in Granular Aquifers.

The method shall be selected based on geologic character of the aquifer, type of drilling rig, and type of screen.

Aquifer Development: For massive, unfractured rock formations unresponsive to well development procedures, the use of aquifer stimulation techniques may be considered to improve well efficiency and specific capacity. Techniques may include dry ice or hydrofracturing, depending on the composition and structure of the formation.

Grouting and Sealing: The annulus surrounding the permanent well casing at the upper terminus of the well shall be filled with expansive hydraulic cement (ASTM C 845), shrinkage-compensating concrete, bentonite based grout, clay, or other material with similar sealing properties. The length of the grout seal shall be no less than 10 feet and not less than the minimum specified in state or locally applicable codes.

If the water is intended for human consumption, the casing shall be surrounded at the ground surface by at least a 4-inch thick concrete slab extending at 2 feet in all directions or as specified in state or locally mandated codes.

A positive seal (grouted in place) or packer shall be provided between the casing and the less pervious material overlying the aquifer of artesian wells, and in all aquifers where co-mingling of waters is undesirable.

Access Port: An access port with a minimum diameter of 0.5 inch shall be installed to allow for unobstructed measurement of depth of the water surface, or for a pressure gage for measuring shut-in pressure of a flowing well. Access ports and pressure gages or other openings in the cover shall be sealed or capped to prevent entrance of surface water or foreign material into the well. Removable caps are acceptable as access ports.

Disinfection: Wells shall be disinfected immediately following their construction or repair to neutralize any contamination from equipment, material, or surface drainage introduced during construction. The four types of water treatment that can be used to remove bacteria are chlorination, ozonation, ultraviolet light, and heat. Chlorination is the most commonly used means of disinfection in both municipal and private water systems. It is recommended that, before selecting a disinfection method, you should check first with local health department officials for recommendations of appropriate methods for their area and for any restrictions or regulations.

Sanitary Protection: Wells shall be located a safe distance from known sources of contamination. Details pertaining to local water wells, such as depth, type of construction, and vertical zone of influence, together with data on the geological formations and porosity of subsoil strata, shall be considered in determining the safe allowable distances. The recommended minimum distance between water supply and source of contamination is:

Source of Contamination
Minimum Distance (ft)

Waste Storage Facilities	
300	
Waste Treatment Lagoons	300
Cesspool	150
Livestock and poultry yards	100
Silo pit, seepage pit	150
Septic tanks	50
Disposal fields	100

If possible, wells shall be located in ground that is higher than any source of contamination or flooding. Drainage that might reach the source from areas used by livestock shall be diverted. Wells must be readily accessible for maintenance and repair and be located a safe distance from overhead utility lines or other safety hazards. Each well shall be provided with a watertight cover or seal to prevent the entry of contaminated water or other objectionable material. A positive seal shall be provided between the casing and the impervious material overlying the aquifer of artesian wells.

Water Quality Testing: Sampling and testing shall comply with all applicable federal, state, and local requirements. These requirements vary according to the water quality parameters associated with the intended use(s) of the water.

CONSIDERATIONS

Installation of this practice should be in consideration of natural resource assessments that may be applicable, such as cultural resources, NEPA, wetland conservation provisions, existing wildlife habitat, and others.

The potential for adverse interference with existing nearby production wells needs to be evaluated in planning.

The potential for groundwater overdraft and the long-term safe yield of the aquifer needs to be considered in planning.

Wells should be located in higher ground and up gradient from sources of contamination or flooding.

Well-drilling contractors are required by the Commonwealth to be licensed through the Kentucky Division of Water Groundwater Branch. Well drillers must pass an examination before they can apply for a license from the DOW. Homeowners should check with the DOW to verify that the well driller they have selected holds a current license.

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared for specific field sites in accordance with this standard and shall describe the requirements for applying the practice to achieve its intended uses. They will meet all state and local requirements.

OPERATION AND MAINTENANCE

A plan for maintenance of a well shall be prepared. The well construction records shall be kept on file with the maintenance plan by the owner/operator. As a minimum, the O & M plan shall include a statement of identified problems, corrective action taken, date, and specific capacity (yield per unit drawdown) of well before and after corrective action was taken.

REFERENCES

1. General Manual, Title 450-GM, Part 405; Subpart A.
2. ASTM A 589 Standard Specification for Seamless and Welded Carbon Steel Water - Well Pipe.
3. ASTM F 480 Standard Specification for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80.
4. ASTM D 2996 Standard Specification for Filament - Wound "Fiberglass" (Glass-Fiber- Reinforced Thermosetting-Resin) Pipe.
5. ASTM D 3517 Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe.
6. ASTM D 5521 Standard Guide for Development of Ground-Water Monitoring Wells in Granular Aquifers.
7. ASTM C 845 Standard Specification for Expansive Hydraulic Cement.
8. General Manual, 190, Part 410, Compliance with NEPA.